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ABSTRACT

This course outline is designed to give students a working knowledge of radio and television theory and servicing techniques. Course content includes goals, specific block objectives, resistance-capacitance circuit characteristics, sawtooth generators sawtooth generator control and production of scanning waveforms, deflection systems, composite television signal, sync-pulse separation, amplification and use, R-F tuners, video IF amplifiers and detectors, video amplifiers, and automatic gain control. Posttest samples and a bibliography are included. (NH)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

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Course Outline
RADIO AND TELEVISION SERVICE - ADVANCED - 9787
(Television Sweep Circuits and Picture Signal Path)
Department 48 - Quin 9787.02

CE002270

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1973

ED 097502

D A D E C O U N T Y P U B L I C S C H O O L S

1 4 5 0 N O R T H E A S T S E C O N D A V E N U E

M I A M I, F L O R I D A 33132

Course Outline

RADIO AND TELEVISION SERVICE - ADVANCED - 9787
(Television Sweep Circuits and Picture Signal Path)

Department 48 - Quin 9787.02

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Dade County Public Schools
Miami, Florida 33132

December, 1972

Published by the School Board of Dade County

Course Description

9787	48	9787.02	Television Sweep Circuits and Picture Signal Path
State Category Number	County Dept. Number	County Course Number	Course Title

This quinmester course is one of a series designed to give the student a working knowledge of radio and television theory and servicing techniques. The course features a study of horizontal, vertical, synchronization, tuner, I.F., video, and A.G.C. circuits of the standard black and white television receiver. Laboratory experiments relating to the text material will be covered. This is a two or three quinmester credit course.

Indicators of Progress: Prior to entry into this course the student must be able to master the skills indicated

Hours: 135

PREFACE

The following pages contain a course outline entitled "Television Sweep Circuits and Picture Signal Path," quinmester course number 9787.02.

This quinmester course, the twelfth in a series of fourteen in radio and television is covered in eleven blocks and is 135 clock hours in length. The course is concluded by a post-test.

Upon completion of this course, the student will be well-versed in the theory of operation of all video and control circuits used in modern black and white television.

The teaching methods will vary according to the ability of the individual student. As the content of the course varies, teaching techniques which lend themselves to each particular situation, are employed. The instructor uses demonstrations and lectures which are supplemented by the performance of laboratory experiments and assignments by the student. The instruction is further developed by the use of films, information sheets, diagrams, and other aids which make the instruction more meaningful.

This outline was developed through the cooperative efforts of instructional and supervisory personnel, the quinmester advisory committee, and the Vocational Curriculum Materials Service, Division of Vocational and Adult Education, and has been approved by the Dade County Vocational Curriculum Committee.

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with Suggested Hourly Breakdown

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RC Circuit Discharge	1
Time Constants of an RC Circuit	1
Formation of Square and Sawtooth Waves	1
II. SAWTOOTH GENERATORS (10 Hours)	
Neon-tube Oscillator	1
Thyratron Oscillator	1
Vacuum-tube Sawtooth Oscillator	1
Transistor Sawtooth Generators	1
III. SAWTOOTH GENERATOR CONTROL AND PRODUCTION OF SCANNING WAVEFORMS (6 Hours)	
Control of Scanning Generators	1
Scanning Requirements for Electromagnetic Picture Tubes	1
Peaking Circuits for Electromagnetic Deflection	1
IV. DEFLECTION SYSTEMS (25 Hours)	
Damping Circuits	1
Vertical Deflection System	1
Early Commercial Deflection Systems	1
Typical Commercial Deflection Systems	1
V. THE COMPOSITE TELEVISION SIGNAL (5 Hours)	
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The Direct-Current Component of the Video Signal	2
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VI. SYNC-PULSE SEPARATION, AMPLIFICATION AND USE	
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Amplification, Clipping, and Shaping	2
Sorting of Horizontal and Vertical Pulses	2
The Function of Vertical Equalizing Pulses	2
Action of the Horizontal Differentiating Circuit During the Vertical Pulse	2

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BLOCK

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Phase Shift 3
Smearing of the Television Image 3
Brightness Control 3
Contrast Control 3
Video Coupling to CRT 3

X. AUTOMATIC GAIN CONTROL (15 Hours)
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XI. QUINMESTER POST TEST

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GOALS

The student will be able to:

1. Demonstrate an understanding of RC circuits and their uses in television to form square and sawtooth waveshapes.

2. Explain the operation of the various types of oscillators used in black and white television receivers.

3. Demonstrate an understanding of sync pulses and their use in black and white television.

4. Understand damping and deflection circuits.

5. Demonstrate an understanding of the component makeup of a modulated video signal and the reasons for DC restoration.

6. Show understanding of the reasons for and methods used in shaping and separating horizontal and vertical sync pulses.

7. Understand the physical and electronic operation of television tuners.

8. Understand the operation of video I-F amplifiers and video detectors.

9. Demonstrate an understanding of the problems involved in video amplification and the methods used to compensate for these problems.

10. Show understanding of the purpose of AGC and the methods used to develop AGC voltages.

11. Satisfactorily complete the post-test.

SPECIFIC BLOCK OBJECTIVES

BLOCK I - RESISTANCE-CAPACITANCE CIRCUIT CHARACTERISTICS

The student must be able to:

1. Draw the charge and discharge curves of the capacitance in an RC circuit, denoting the voltage at the end of one time constant.
2. Demonstrates an understanding of the formula for RC time constants by correctly working the problems assigned by the instructor.
3. Define the terms "integrator voltage" and "differentiator voltage" as they apply to RC networks, stating the waveform that each takes, which component develops each, and the waveform which must be applied to the network to develop these voltages.

BLOCK II - SAWTOOTH GENERATORS

The student must be able to:

1. Name three types of sawtooth generators used in black and white television.
2. State two differences between the symmetrical, or balanced, multivibrator and the asymmetrical, or unbalanced multivibrator.
3. Demonstrate the ability to recognize the schematic diagram of two types of multivibrators and the conventional blocking oscillator by correctly naming each when shown a group of diagrams which includes these three.
4. When given a schematic diagram of a conventional multivibrator, explain the sequence of events which take place through one complete cycle.

BLOCK III - SAWTOOTH GENERATOR CONTROL AND PRODUCTION OF SCANNING WAVEFORMS

The student must be able to:

1. State orally the number of horizontal lines required to make up one picture frame.
2. Write the meaning of the term "synchronizing frequency" in fifteen words or less.
3. State orally the synchronizing frequency for vertical and horizontal synchronization in a television.
4. Describe the waveforms that must be applied to a pure resistance, a pure inductance, and a series RL network in order to obtain a sawtooth current waveform.

BLOCK IV - DEFLECTION SYSTEMS

The student must be able to:

1. Name at least three circuits to which boost voltage is applied.
2. Demonstrate an understanding of boost voltage by naming the circuit which develops this voltage and explaining the action which occurs.

3. State orally the purpose of the damper circuit.
4. Explain the purpose of the horizontal stabilizing coil in a television receiver.

BLOCK V - THE COMPOSITE TELEVISION SIGNAL

The student must be able to:

1. Explain the meaning of vestigial-sideband modulation and make a rough drawing of a television channel employing this type of modulation.
2. State the frequency range of the upper and lower sidebands produced by video modulation.
3. List two reasons for the choice of negative video modulation for television transmission in the United States.

BLOCK VI - SYNC-PULSE SEPARATION, AMPLIFICATION, AND USE

The student must be able to:

1. Explain the purpose of a noise inverter circuit in 25 words or less.
2. List two reasons for using cascaded integrating circuits.
3. Draw the schematic diagram of a simple integrator network.
4. Draw the schematic diagram of a simple RC differentiator.

BLOCK VII - R-F TUNERS

The student must be able to:

1. Name the three major tuner stages.
2. List the three types of tuners used in modern receivers.

BLOCK VIII - VIDEO IF AMPLIFIERS AND DETECTORS

The student must be able to:

1. Define intercarrier sound in 25 words or less.
2. Name two methods used to obtain the wideband IF response required for a television receiver.
3. List three of the four types of circuits which may be used to accomplish adjacent-channel rejection.
4. List two ways in which video detection differs from audio detection in an AM receiver.
5. Draw an overall video response curve and label the trap frequencies.

BLOCK IX - VIDEO AMPLIFIERS

The student must be able to:

1. Name the two methods used to compensate for high frequency losses in video amplifiers.
2. List two visual effects caused by phase shift in a video amplifier.

BLOCK X - AUTOMATIC GAIN CONTROL

The student must be able to:

1. List three types of AGC.
2. Explain to the satisfaction of the instructor, the purpose of delayed AGC.
3. Name the signals required for keyed AGC and the points of application.

BLOCK XI - QUINMESTER POST TEST

The student must be able to:

1. Satisfactorily complete the post test.

Course Outline

RADIO AND TELEVISION SERVICE - ADVANCED - 9787
(Television Sweep Circuits and Picture Signal Path)

Department 48 - Quin 9787.02

I. RESISTANCE-CAPACITANCE CIRCUIT CHARACTERISTICS

A. RC Circuit Charging

B. RC Circuit Discharge

C. Time Constants of an RC Circuit

D. Formation of Square and Sawtooth Waves

II. SAWTOOTH GENERATORS

A. Neon-tube Oscillator

B. Thyratron Oscillator

C. Vacuum-tube Sawtooth Oscillator
   1. Multivibrators
   2. Blocking Oscillator

D. Transistor Sawtooth Generators

III. SAWTOOTH GENERATOR CONTROL AND PRODUCTION OF SCANNING WAVEFORMS

A. Control of Scanning Generators

B. Scanning Requirement for Electromagnetic Picture Tubes

C. Peaking Circuits for Electromagnetic Deflection

IV. DEFLECTION SYSTEMS

A. Damping Circuits

B. Vertical Deflection System

C. Early Commercial Deflection Systems
   1. Horizontal oscillators
   2. Horizontal output systems

D. Typical Commercial Deflection Systems
   1. Vertical Deflection Systems
   2. Horizontal Deflection Systems

V. THE COMPOSITE TELEVISION SIGNAL

A. Vestigial Sideband Video Modulation

B. The Video Signal

C. The Direct-Current Component of the Video Signal

D. Sync Pulses

VI. SYNC-PULSE SEPARATION, AMPLIFICATION, AND USE

A. Review of Vacuum Tube Applications

B. Sync-pulse Separation
   1. Diode separation circuits
   2. Pentode separation circuits
   3. Gated separation circuits

C. Amplification, Clipping, and Shaping
   1. Sync Pulses
   2. Age

D. Sorting of Horizontal and Vertical Pulses
   1. Horizontal pulse separation
   2. Vertical pulse separation

E. The Function of Vertical Equalizing Pulses

F. Action of the Horizontal Differentiating Circuit During the Vertical Pulse

VII. R-F TUNERS

A. Pentode R-F Amplifiers
   1. Applications
   2. Advantages
   3. Disadvantages

B. Triode R-F Amplifiers
   1. Advantages
   2. Disadvantages

C. Neutrode R-F Amplifiers
   1. Advantages
   2. Disadvantages

D. Tetrode R-F Amplifiers
   1. Advantages
   2. Disadvantages

VII. R-F TUNERS (Contd.)

E. Cascode R-F Amplifiers
   1. Noise Factor
   2. Other disadvantages

F. Tuning Systems
   1. Wafer
   2. Turret
   3. Disc

G. UHF Tuners
   1. Tube type
   2. Diode Type

VIII. VIDEO I-F AMPLIFIERS AND DETECTORS

A. Video I-F Systems
   1. Response
   2. Rejection

B. Video Detectors

IX. VIDEO AMPLIFIERS

A. Effect of Plate-load Resistor on Bandwidth and Gain
   1. Low frequency compensation
   2. High frequency compensation

B. Phase Shift
   1. Low frequency phase shift
   2. High frequency phase shift
   3. Ideal phase shift

C. Smearing of the Television Image

D. Brightness Control

E. Contrast Control

F. Video Coupling to CRT

X. AUTOMATIC GAIN CONTROL

A. Rectified AGC

B. Amplified AGC

C. Keyed AGC

D. Delayed AGC for R-F Stage

XI. QUINMESTER POST TEST

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8. _____. Symfact Guide to TV Servicing. Indianapolis: Howard W. Sams & Co., 1970. Pp. 160.

9. _____. Television Service Manual. 3rd ed. Indianapolis: Howard W. Sams & Co., 1970. Pp 544.

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2. Localizing Troubles (Television). 16 mm. 11 min. BW. Sound. McGraw Hill. #1-05519.

3. Practical TV Alignment. 16 mm. 16 min. BW. Sound. McGraw-Hill. #1-13108.

4. Television: How it Works. 16mm. 11 min. BW. Sound. Coronet. #1-03548.

5. Typical TV Interference Patterns. 16 mm. 10 min. BW. Sound. UW. #1-05594.

A P P E N D I X

Quinmester Post-Test Samples

Quinmester Post-Test

Name _____ Date _____ Score ____

I. True-False Test Items - Each of the following statements is either true or false. If the statement is true, draw a circle around the letter T following it; if the statement is false, draw a circle around the F. If a statement is false in part, it is entirely false.

1. Theoretically, a capacitor in an R-C network is fully charged at the end of three time constants. T F

2. The larger the capacitance in an R-C network the more distorted will be the waveshape across the resistor, for a square wave input. T F

3. In an R-C network the voltage across the capacitor rises exponentially while a steady voltage is applied. T F

4. In the formula t= RC, if R is in ohms and C is in farads, then t is the number of seconds required to fully charge a capacitor. T F

5. In a conventional multivibrator, tube conduction occurs immediately upon the application of voltage to the circuits. T F

6. Each picture frame consists of 525 horizontal lines. T F

7. Synchronizing frequency is the rate of application of pulses to the control input terminal of an oscillator. T F

8. The purpose of the damper tube is to load the deflection circuit and thereby stop oscillations. T F

9. The output of the video detector must be negative whenever there is only one video amplifier stage. T F

10. The yoke in a TV receiver is used to focus the electron beam. T F

Quinmester Post-Test

Name _____ Date _____ Score ____

II. Multiple Choice Test Items - Each statement needs a word, a figure, or a phrase to make it correct. Only one of the choices listed is correct. Place the number of the choice you make in the space provided at the right edge of the sheet.

1. Vestigial sideband transm ssion is (1) transmission with one sideband completely suppressed, (2) double sideband transmission, (3) transmission of both sidebands with signal information on only one, (4) partial suppression of one sideband. ( )

2. The type of modulation used to apply video information to its carrier is (1) frequency modulation, (2) Amplitude modulation, (3) phase modulation, (4) single-sideband. ( )

3. TV channels 2 through 13 are in the frequency range called (1) EHF, (2) VLF, (3) UHF, (4) VHF. ( )

4. Another name for a flyback is (1) horizontal oscillator transformer, (2) vertical output transformer, (3) horizontal output transformer, (4) spring-return fine tuner. ( )

5. Another name for the RF section is (1) tuner, (2) antenna matching network, (3) video IF, (4) all those stages that work with RF signals. ( )

6. The purpose of AGC is to (1) keep the peak amplitude of the final IF signal essentially constant, (2) keep the signal from overdriving the sync, (3) make certain there is no snow in the picture, (4) make the sync pulses arrive on time. ( )

7. The purpose of a noise inverter circuit is to (1) to invert the polarity of the audio signal in order to drive the speaker correctly, (2) cancel out interference in the sync, (3) remove noises in the composite video signal, (4) invert the audio signal for ease in detection. ( )

8. High frequency response is accomplished in the video section of a television receiver by means of (1) high capacitance between stages, (2) low capacitance between stages, (3) peaking coils, (4) none of the above ( )

9. Phase detection is normally used in a black and white TV receiver in the (1) sync circuit, (2) vertical circuit, (3) horizontal circuit, (4) video circuit. ( )

10. High voltage in a Television is generated during which part of the scan period (1) horizontal trace, (2) horizontal retrace, (3) vertical trace, (4) vertical retrace. ( )

Quinmester Post-Test

Name _____ Date _____ Score ____

III. Completion Test Items - Fill in the blank or blanks with the word or words that make the statement correct.

1. The total bandwidth of each VHF television channel is _____ hertz.

2. The horizontal scan frequency is _____ hertz.

3. In the United States the TV picture is made up of _____ scan lines.

4. There are _____ frames per second in American television.

5. The type of waveshape applied to the control grid of the horizontal output tube is a _____ waveform.

6. The aspect ratio of the standard rectangular CRT is _____.

7. The three basis tuner stages are _____, _____, and _____.

8. The type of deflection used in TV today is _____ deflection.

9. The bandwidth of each UHF channel is _____ mega-hertz.

10. The numerical channel designations for the UHF band are _____ through _____.

Quinmester Post-Test

Name _____ Date _____ Score ____

IV. In the figures shown below, each waveshape is developed across a specific component of an R-C network and has a specific name. From the list below the waveshapes choose the correct name of the voltage, the name of the waveshape, and the name of the component across which it is developed. Write your choices in the spaces provided to the left of each waveshape.

I. a._____ (VOLTAGE)

b._____ (WAVESHAPE)

c._____ (COMPONENT)

II. a._____ (VOLTAGE)

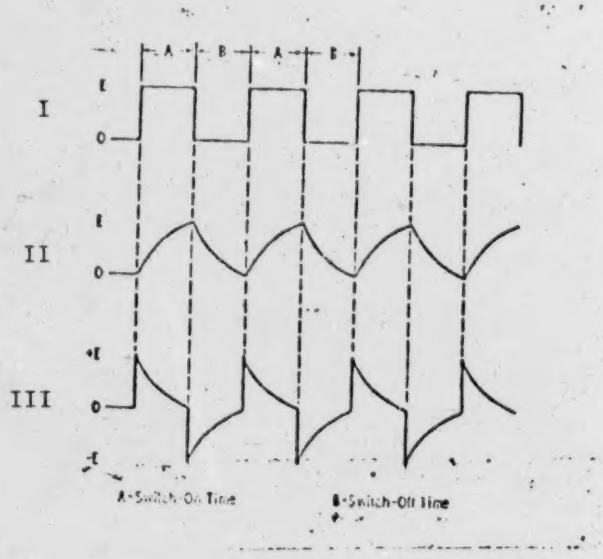
b._____ (WAVESHAPE)

c._____ (COMPONENT)

III. a._____ (VOLTAGE)

b._____ (WAVESHAPE)

c._____ (COMPONENT)



INTEGRATOR VOLTAGE	SQUARE WAVE	DISTORTED SQUARE WAVE
GENERATOR	RESISTOR	APPLIED VOLTAGE
CAPACITOR	SAWTOOTH	DIFFERENTIATOR VOLTAGE

Key for Post-Test

I. TRUE-FALSE

1. F
2. F
3. T
4. F
5. F
6. T
7. T
8. T
9. F
10. F

II. MULTIPLE CHOICE

1. 4
2. 2
3. 4
4. 3
5. 1
6. 1
7. 2
8. 3
9. 3
10. 2

III. COMPLETION

1. 6 mega-
2. 15,750
3. 525
4. 30
5. sawtooth
6. 4 to 3
7. RF, oscillator and mixer
8. Electromagnetic
9. 6
10. 14 through 83

IV. RECOGNITION

I. a. applied voltage
   b. square wave
   c. generator

II. a. integrator voltage
    b. sawtooth
    c. capacitor

III. a. differentiator voltage
     b. distorted square wave
     c. resistor